Application No.: 10/055,635

Reply to office action of May 19, 2004

Amendments to the Claims

Listing of Claims

This listing of the claims will replace all prior versions, and listings, of claims in the application.

CLAIMS

1.   (Canceled)

2.   (Amended) ~~The method of claim 1,~~ A method of copying data, comprising operations of:

receiving a request to copy a body of source data to specified target storage;

reviewing contents of the source data to identify data objects therein;

for each identified data object, performing copy operations comprising:

consulting prescribed metadata records to determine whether a copy of the identified data object already exists in the target storage;

only if a copy does not already exist, performing operations comprising:

applying prescribed criteria to determine whether the identified data object qualifies for copying;

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forming a copy of the identified data object in target storage, comprising:

if the data object qualifies for copying, writing the data object to the target storage;

if the data object does not qualify for copying, instead of writing the data object writing a predetermined bit pattern to the specified target storage;

responsive to completion of the forming operation, updating the metadata records to indicate that the data object exists in the specified target storage regardless of whether the data object was replaced with a predetermined bit pattern rather than being physically written to the specified target storage;

the reviewing operation comprising reviewing contents of the source data to identify individual data objects therein, and also reviewing any aggregate data objects in the source data to identify all constituent data objects thereof;

where the applying and forming operations are performed separately for each data object whether in individual or aggregated form;

where the operation of updating the metadata records comprises,

for each data object comprising an individual data object, preparing a record indicating that the data object exists in the specified target

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storage regardless of whether the data object was replaced with the predetermined bit pattern rather than being written to the specified target storage;

for each data object comprising an aggregated data object, preparing a record indicating that the data object exists in the specified target storage regardless of whether any constituent data objects were replaced with the predetermined bit pattern rather than being written to the specified target storage.

3.   (Original) The method of claim 2, for each data object comprising an aggregated data object, further comprising one of the following operations:

forming a record indicating whether the aggregated data object contains any constituent user files replaced with the predetermined bit pattern;

forming a record specifically identifying any constituent user files replaced with the predetermined bit pattern.

4.   (Original) The method of claim 2, further responsive to completion of the forming operation, performing operations comprising preparing a metadata record to identify each individual data object that was replaced with a predetermined bit pattern rather than being written to target storage.

5.   (Original) The method of claim 2, the operations further comprising:

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receiving a request to restore one or more specified data objects from the target

storage to a specified restore site;

for each specified data object, performing restore operations comprising:

consulting the metadata records to identify one or more copies of the

specified data object in the target storage;

if the specified data object is an individual data object, searching the

metadata records to locate a copy in which the data object was not

replaced with the predetermined bit pattern;

if the specified data object is an aggregate data object, searching the

metadata records to locate copies of the constituent data objects in

which the constituent data objects were not replaced with the

predetermined bit pattern;

copying each copy located by the search to a specified restore site.

6.   (Canceled)

7.   (Canceled)

8.   (Canceled)

9.   (Amended) ~~The medium of claim 8,~~ A signal-bearing medium tangibly embodying

a program of machine-readable instructions executable by a digital processing

apparatus to perform operations to copy data, comprising:

receiving a request to copy a body of source data to specified target storage;

reviewing contents of the source data to identify data objects therein;

for each identified data object, performing copy operations comprising:

consulting prescribed metadata records to determine whether a copy of the identified data object already exists in the target storage;

only if a copy does not already exist, performing operations comprising:

applying prescribed criteria to determine whether the identified data object qualifies for copying;

forming a copy of the identified data object in target storage, comprising:

if the data object qualifies for copying, writing the data object to the target storage;

if the data object does not qualify for copying, instead of writing the data object writing a predetermined bit pattern to the specified target storage;

responsive to completion of the forming operation, updating the metadata records to indicate that the data object exists in the specified target storage regardless of whether the data object was replaced with a predetermined bit pattern rather

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than being physically written to the specified target storage;

the reviewing operation comprising reviewing contents of the source data to

identify individual data objects therein, and also reviewing any aggregate

data objects in the source data to identify all constituent data objects

thereof;

where the applying and forming operations are performed separately for each

data object whether in individual or aggregated form;

where the operation of updating the metadata records comprises,

for each data object comprising an individual data object, preparing a

record indicating that the data object exists in the specified target

storage regardless of whether the data object was replaced with

the predetermined bit pattern rather than being written to the

specified target storage;

for each data object comprising an aggregated data object, preparing a

record indicating that the data object exists in the specified target

storage regardless of whether any constituent data objects were

replaced with the predetermined bit pattern rather than being

written to the specified target storage.

10. (Original) The medium of claim of claim 9, the operations further comprising, for

each data object comprising an aggregated data object, one of the following operations:

forming a record indicating whether the aggregated data object contains any

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constituent user files replaced with the predetermined bit pattern;

forming a record specifically identifying any constituent user files replaced with
the predetermined bit pattern.

11.   (Original) The medium of claim 9, further responsive to completion of the forming
operation, performing operations comprising preparing a metadata record to identify
each individual data object that was replaced with a predetermined bit pattern rather
than being written to target storage.

12.   (Original) The medium of claim 8, the operations further comprising:

receiving a request to restore one or more specified data objects from the target
storage to a specified restore site;

for each specified data object, performing restore operations comprising:

consulting the metadata records to identify one or more copies of the
specified data object in the target storage;

if the specified data object is an individual data object, searching the
metadata records to locate a copy in which the data object was not
replaced with the predetermined bit pattern;

if the specified data object is an aggregate data object, searching the
metadata records to locate copies of the constituent data objects in

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which the constituent data objects were not replaced with the

predetermined bit pattern;

copying each copy located by the search to a specified restore site.

13. (Canceled)

14. (Canceled)

15. (Amended) A logic circuit of multiple interconnected electrically conductive elements configured to perform operations to copy data comprising:

receiving a request to copy a body of source data to specified target storage;

reviewing contents of the source data to identify data objects therein;

for each identified data object, performing copy operations comprising:

consulting prescribed metadata records to determine whether a copy of the identified data object already exists in the target storage;

only if a copy does not already exist, performing operations comprising:

applying prescribed criteria to determine whether the identified data object qualifies for copying;

forming a copy of the identified data object in target storage, comprising:

if the data object qualifies for copying, writing the data object

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to the target storage;

if the data object does not qualify for copying, instead of writing the data object writing a predetermined bit pattern to the specified target storage;

responsive to completion of the forming operation, updating the metadata records to indicate that the data object exists in the specified target storage regardless of whether the data object was replaced with a predetermined bit pattern rather than being physically written to the specified target storage;

the reviewing operation comprising reviewing contents of the source data to identify individual data objects therein, and also reviewing any aggregate data objects in the source data to identify all constituent data objects thereof;

where the applying and forming operations are performed separately for each data object whether in individual or aggregated form;

where the operation of updating the metadata records comprises,

for each data object comprising an individual data object, preparing a record indicating that the data object exists in the specified target storage regardless of whether the data object was replaced with the predetermined bit pattern rather than being written to the specified target storage;

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for each data object comprising an aggregated data object, preparing a record indicating that the data object exists in the specified target storage regardless of whether any constituent data objects were replaced with the predetermined bit pattern rather than being written to the specified target storage.

16.   (Amended) A data storage system, comprising:

digital data storage including a body of source data;

metadata;

a storage director, programmed to perform copy operations comprising:

receiving a request to copy a body of source data to specified target storage of the digital data storage;

reviewing contents of the source data to identify data objects therein;

for each identified data object, performing copy operations comprising:

consulting the metadata to determine whether a copy of the identified data object already exists in the target storage;

only if a copy does not already exist, performing operations comprising:

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applying prescribed criteria to determine whether the

identified data object qualifies for copying;

forming a copy of the identified data object in target storage,

comprising:

if the data object qualifies for copying, writing the data

object to the target storage;

if the data object does not qualify for copying, instead

of writing the data object writing a

predetermined bit pattern to the specified

target storage;

responsive to completion of the forming operation, updating

the metadata to indicate that the data object exists in

the specified target storage regardless of whether the

data object was replaced with a predetermined bit

pattern rather than being physically written to the

specified target storage;

the reviewing operation comprising reviewing contents of the source data to

identify individual data objects therein, and also reviewing any aggregate

data objects in the source data to identify all constituent data objects

thereof;

where the applying and forming operations are performed separately for each

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data object whether in individual or aggregated form;

where the operation of updating the metadata comprises,

for each data object comprising an individual data object, preparing a record indicating that the data object exists in the specified target storage regardless of whether the data object was replaced with the predetermined bit pattern rather than being written to the specified target storage;

for each data object comprising an aggregated data object, preparing a record indicating that the data object exists in the specified target storage regardless of whether any constituent data objects were replaced with the predetermined bit pattern rather than being written to the specified target storage.

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17.   (Amended) A data storage system, comprising:

first means for storing digital data storage including a body of source data;

second means for storing metadata;

third means for copying data of the digital storage by:

receiving a request to copy a body of source data to specified target
storage in the first means;

reviewing contents of the source data to identify data objects therein;

for each identified data object, performing copy operations comprising:

consulting the second means to determine whether a copy of the
identified data object already exists in the target storage;

only if a copy does not already exist, performing operations
comprising:

applying prescribed criteria to determine whether the
identified data object qualifies for copying;

forming a copy of the identified data object in target storage,
comprising:

if the data object qualifies for copying, writing the data
object to the target storage;

if the data object does not qualify for copying, instead

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of writing the data object writing a

predetermined bit pattern to the specified

target storage;

responsive to completion of the forming operation, updating

the second means to indicate that the data object

exists in the specified target storage regardless of

whether the data object was replaced with a

predetermined bit pattern rather than being physically

written to the specified target storage;

the reviewing operation comprising reviewing contents of the source data to

identify individual data objects therein, and also reviewing any aggregate

data objects in the source data to identify all constituent data objects

thereof;

where the applying and forming operations are performed separately for each

data object whether in individual or aggregated form;

where the operation of updating the second means comprises,

for each data object comprising an individual data object, preparing a

record indicating that the data object exists in the specified target

storage regardless of whether the data object was replaced with

the predetermined bit pattern rather than being written to the

specified target storage;

for each data object comprising an aggregated data object, preparing a record indicating that the data object exists in the specified target storage regardless of whether any constituent data objects were replaced with the predetermined bit pattern rather than being written to the specified target storage.

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